Wetlands of the Lower Macleay Floodplain, Northern Coastal New South Wales

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A survey of wetlands on the lower Macleay floodplain in 1984 involved mapping and description of 432 wetlands with a total area of nearly 12,800 ha. Most wetlands were less than 10 ha and the three largest accounted for 73% of the total area. One hundred and eighteen plant taxa and two categories of open water were recorded. Open water occupied only 2.5% of the total wetland area but some open water occurred in 54% of wetlands. The most extensive and frequently occurring plant families were Polygonaceae (covering 26% of the wetland area, occurring in 97% of the total number of wetlands), Poaceae (28% area, 91% number), Juncaceae (10% area, 91% number), Cyperaceae (20% area, 63% number) and Myrtaceae (6% area, 21% number). Broad fringing bands of herbaceous plants were typical of the wetlands. Most wetlands had few trees on their margins due to clearing. About 99% of wetlands were grazed. Drainage affected 51% of the total number and 96% of the total wetland area. Most wetlands are seasonal and have relatively small catchments restricted to the alluvial flats. Twenty-one percent of wetlands have catchments on adjacent hillslopes and ranges. Agriculture was by far the dominant land use in wetland catchments. Most wetlands were freehold and only one is covered (partly) by a reserve for nature conservation.

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INTRODUCTION

The wetlands of the Macleay floodplain have not previously been mapped or surveyed in a detailed and comprehensive way. In a broad-scale survey of the State's coastal wetlands, Goodrick (1970) mapped and classified many on the Macleay floodplain, including all the major ones. His study outlined the types and distribution of coastal wetlands and estimated their decline up to 1969. However, it lacked the detailed information needed to decide priorities for conservation and management. The only other inventory of wetlands on the Macleay floodplain was by the Coastal Council of New South Wales (1985) which mapped many of them for zoning purposes without describing or classifying them. Another broad survey by West *et al.*, (1985) dealt exclusively with the estuarine wetlands of the Macleay and other parts of the coast.

There are few detailed studies on the flora and fauna of the Macleay floodplain wetlands and none of these has covered more than a few of the total number of wetlands. Broome (1978) identified the habitat associations of waterbirds and studied the dynamics of their populations at a few selected sites. The remaining studies on the wetlands of the floodplain are mainly concerned with geomorphology and soils (Pressey, 1981).

This paper summarizes the results of a detailed inventory and description of all the wetlands on the lower Macleay floodplain (see Pressey, 1987). The survey was part of a series of studies on coastal wetlands undertaken for the New South Wales National Parks and Wildlife Service. The area and aims of the surveys and the types of data collected are outlined in the accompanying paper on the Clarence floodplain wetlands (Pressey, 1989).

Study Area

The Macleay River floodplain is situated on the mid-north coast of New South Wales, approximately 350 km north-east of Sydney (Fig. 1). As for the Clarence survey, the lower Macleay floodplain was defined as alluvium below the 10 m contour. This boundary contains virtually all of the alluvial wetland in the Macleay system and encloses the extensive deltaic alluvial plain that has formed during and since the last rise in sea level. The floodplain above the 10 m contour is restricted to a narrow strip along the river and the wetlands are generally small and scattered. The survey was also restricted to predominantly fresh wetlands and excluded estuarine and most brackish areas.

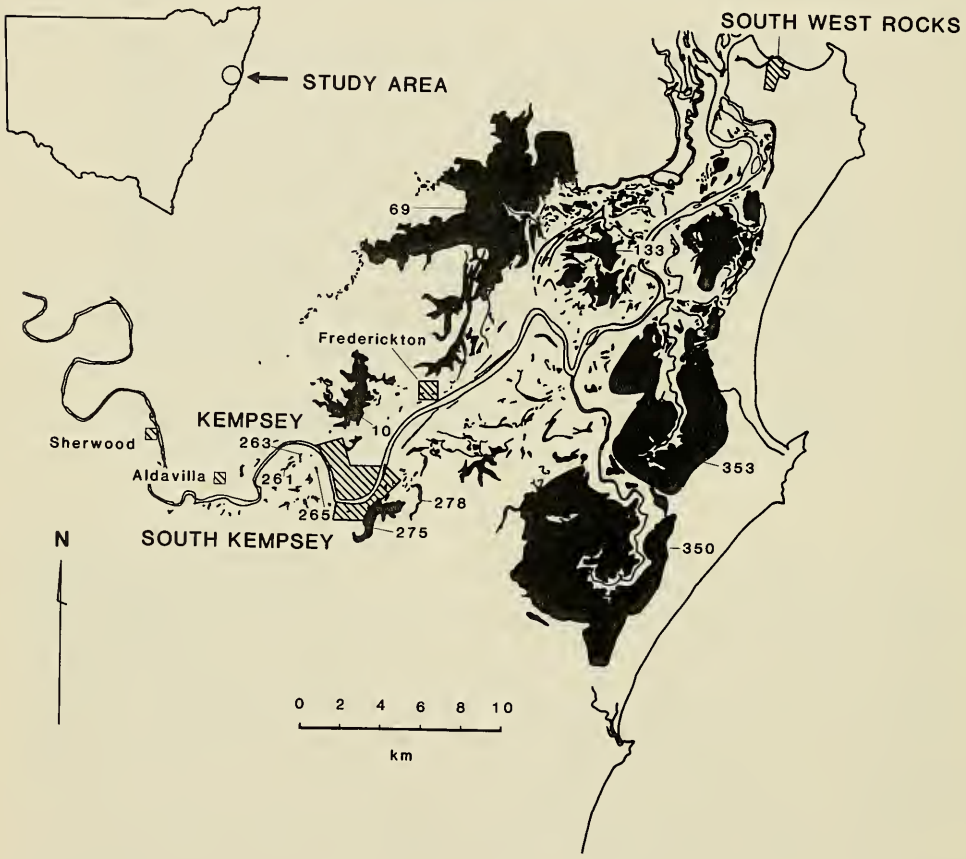

Fig. 1. The study area. Numbers are those given to named wetlands during the survey. The names corresponding to these numbers are: 10 Christmas Creek; 69 Doughboy Swamp/Sevenoaks Swamp/Clybucca Swamp; 133 Cooroobongatti Swamp; 261 Chapmans Creek; 263 Chapmans Creek; 265 Chapmans Creek; 275 East Kempsey Swamps/Bridge Creek; 278 Pola Creek; 350 Belmore Swamp; 353 Swan Pool/Kinchela Swamp.

The study area occupies about 400 sq. km (Fig. 1). To the north of the river it extends upstream as far as Aldavilla. On this side, a large area of alluvium lies adjacent to Christmas Creek, immediately north of Kempsey, but the bulk of the northern floodplain is to the north and east of Frederickton where continuous alluvium extends for some 140 sq. km. The dominant wetland area here is the large Doughboy, Sevenoaks or

Clybucca Swamp in the north-west of the study area. To the south of the river the study area extends upstream almost to Sherwood. Most of the southern alluvium lies in a continuous tract of about 180 sq. km downstream of South Kempsey. The largest wetland areas here are the Swan Pool, formerly known as Kinchela Swamp, and Belmore Swamp.

The main land use on the Macleay floodplain is grazing for dairying and beef. Relatively small areas have been planted to poplars and to crops such as sorghum and corn. As on the Clarence floodplain, drainage of wetlands began late in the nineteenth century to improve pasture production. Drainage trusts or unions were formed around the turn of the century to co-ordinate drainage schemes. From the late 1950s, under flood mitigation schemes, drains, floodgates and levees were constructed and integrated to minimize damage to urban and agricultural land from flooding. They extended and intensified the alteration of wetlands caused by earlier drainage.

Goodrick (1970) found that about 49% of all wetlands on the mid-north coast, which includes the Macleay floodplain, had been lost or significantly altered before 1970, mainly to drainage and flood mitigation. This decline or alteration includes about 14,800 ha of shallow floodplain wetlands, representing about 68% of the wetlands lost or altered. The impacts on floodplain wetlands are likely to be more extensive today since flood mitigation on the lower Macleay has continued since Goodrick's survey (Pressey and Middleton, 1982).

Methods

Initial identification of wetlands was from black and white or colour aerial photographs taken between 1979 and 1981 at scales of 1:25 000 and 1:50 000. The wetlands were each visited at least once during two field surveys (6.12.83 — 21.12.83 and 6.1.84 — 27.1.84).

Of thirteen attributes of each wetland recorded in the field and/or remotely from maps and aerial photographs, six were used only for ranking the wetlands for conservation (see Pressey, 1987). The remaining seven — size, vegetation/habitats, marginal vegetation, alteration, catchment areas, catchment land use, and tenure — were used descriptively and are discussed in this paper.

Methods of recording the seven descriptive attributes are given in the preceding paper on the Clarence wetlands (Pressey, 1989). Differences in recording plant taxa in the Macleay wetlands were that more time was spent searching for plants, species in the families Azollaceae and Lemnaceae were included, and all plants were identified at least to species level. Authorities for plant names are those in Jacobs and Pickard (1981) as amended by Jacobs and Lapinpuro (1986), unless indicated otherwise.

Results and Discussion

The survey covered 432 wetlands with a total area of 12,772 ha. Most of the wetlands are small, 90% being 10 ha or smaller (Table 1). These small wetlands account for less than 6% of the total wetland area. The bulk of the wetland area (89%) is made up by the relatively small number (3% of the total) greater than 100 ha in size. The three largest wetlands account for 73% of the total wetland area.

The recorded plant taxa, including a hybrid *Juncus*, an undescribed species of *Myriophyllum*, and two forms of *Persicaria strigosa*, totalled 118. Their occurrence in the study area, with that of the two recorded categories of open water, is summarized in the Appendix.

The two forms of *Persicaria strigosa* differed in features and habitat. *P. strigosa* FORM 1 was the less common. It is characterized by large green leaves with cordate bases,

bristles beneath the dense glandular hairs on the peduncles, and white flowers in a large, compact, ovate spike. It was found generally along the edges of relatively permanent, steep-sided channels and in other sheltered, damp areas that are rarely inundated. *P. strigosa* FORM 2 has reddish leaves that are more lanceolate than FORM 1, frequently with hastate bases. In addition, there are no bristles beneath the glandular hairs on the peduncles and the spike of white flowers is linear to ovate and occasionally interrupted. It was found growing in dense meadows in relatively persistent standing water, particularly in wetlands with large catchments or in those adjacent to perennial streams. FORM 2 is the more similar to *P.* sp. B in terms of leaf shape and inflorescence structure.

TABLE 1

Size distribution of wetlands

Area (ha)	No. of wetlands	% Total no.	Wetland area (ha)	% Total area
0-1.0	190	44.0	107.5	0.8
1.1-5.0	162	37.5	368.8	2.9
5.1-10.0	37	8.6	254.5	2.0
10.1-50	28	6.5	526	4.1
51-100	3	0.7	200	1.6
101-500	8	1.8	1415	11.1
501-1000	1	0.2	530	4.1
>1000	3	0.7	9370	73.4
	432	100.0	12771.8	100.0

Open water was relatively unimportant in terms of the overall wetland area occupied (Appendix). Some shallow open water occurred in about half the number of wetlands but totalled, at the time of the survey, only about 290 ha or 2.3% of total wetland area. Deep open water was much more restricted in distribution and extent. The scarcity of open water in the wetlands of the mid-north coast generally is indicated by estimates from Goodrick's (1970) report (Table 2). The five categories of Goodrick's classification that make up the bulk of the wetland area in the region, and on the Macleay floodplain, contain relatively little open water and are dominated by herbaceous emergents and by trees.

Completion of all the field work in mid-summer following heavy rains provided ideal conditions for the identification of a large number of wetland plant taxa. Some shallow seasonal wetlands contained so much water that the results of the survey may be atypical to some extent. Of the plant taxa recorded, one is a liverwort, seven are ferns, 67 are monocotyledons and 43 are dicotyledons. The most diverse families were Cyperaceae (30 taxa), Polygonaceae (12), Juncaceae (11) and Poaceae (10). The largest number of native taxa recorded in a wetland was 46, although most wetlands contained relatively few (Table 3). There is a significant relationship between wetland size and number of plant taxa in the wetlands on the Macleay floodplain (Margules *et al.*, 1988) although there is considerable variability in the number of taxa in wetlands of any size. Most taxa occurred in relatively few wetlands and occupied a relatively small overall area (Table 4).

Monocotyledonous plants occupied some 62% of the total wetland area and occurred in all but one wetland (Appendix). The most important monocot families, in terms of extent and frequency of occurrence, were Poaceae (28% of total wetland area, 91% of total number of wetlands), Juncaceae (10% area, 91% number) and Cyperaceae (22% area, 63% number). *Paspalum distichum* (water couch) and *Juncus polyanthemus* x *usitatus* were the most extensive and frequently occurring taxa in the Poaceae and

Juncaceae, respectively. *Eleocharis equisetina* made up most of the area occupied by the Cyperaceae and was one of the most frequently occurring sedges. Dicotyledons occupied 35% of the wetland area and occurred in all but three wetlands. Polygonaceae (26% area, 97% number) and Myrtaceae (6% area, 21% number) were the major dicot families. *Persicaria hydropiper* and *Melaleuca quinquenervia* were, respectively, the most extensive and commonly recorded species in these families.

TABLE 2

Extent and decline of wetland types on the mid-north coast of New South Wales (modified from Goodrick, 1970)#

Wetland type	Original area (ha)	1969 area (ha)	% Decline
fresh meadows	18590	(2430)	79.7
seasonal fresh swamps		(1340)	
semi-permanent fresh swamps	120	120	–
open fresh waters*	40	40	–
shallow saline lagoons	650	650	–
teatree swamps	7490	6560	12.4
salt meadows	3520	3520	–
reed swamps	2880	810	71.9
salt flats	160	160	–
mangrove swamps	1170	1170	–
coastal bogs	1940	1940	–
coastal *Lepironia* swamps	40	40	–
	36600	18780	48.7

estimates excluded two wetland types: shallow estuarine waters and sheoak swamps.

* open fresh waters is the only floodplain wetland category identified by Goodrick as being dominantly open water, although relatively small areas of open water occur in other categories on the Macleay floodplain.

Underlined categories are those occurring on the Macleay floodplain.

TABLE 3

Numbers of native plant taxa in wetlands

Taxa	No. wetlands	% Total no.
>30	4	0.9
26-30	3	0.7
21-25	9	2.1
16-20	31	7.2
11-15	101	23.4
6-10	174	40.2
0-5	110	25.5
	432	100.0

Twenty of the species recorded are introduced. They occupied about 180 ha or 1.5% of total wetland area at the time of the survey. The most extensive were *Eichhornia crassipes* (94 ha), *Salvinia molesta* (33 ha) and *Echinochloa crus-galli* (31 ha). The first two mentioned are particularly troublesome floating weeds and had completely blanketed and infilled some wetlands. *Cyperus brevifolius* may be native to parts of northern Australia although it is considered to be introduced to the study area (K. Wilson, Natnl. Herb. N.S.W., pers. comm.).

Four recorded species, *Commelina cyanea*, *Cyperus polystachyos*, *Pseudognaphalium luteoalbum* and *Ranunculus plebeius*, are widely distributed in non-wetland habitats, particu-

larly in higher rainfall areas. A further six species, *Bacopa monnieri*, *Bolboschoenus caldwellii*, *Juncus kraussii*, *Schoenoplectus litoralis*, *Sporobolus virginicus* and *Triglochin striata*, are typical of brackish and estuarine habitats and occur only marginally in freshwater floodplain wetlands.

TABLE 4

Frequency of occurrence of plant taxa in wetlands according to % number of wetlands and % total wetland area (bracketed figures indicate number of introduced species in percentage classes)

Percentage class	No. taxa (% no. wetlands)	No. taxa (% wetland area)
0-1.0	39(9)	107(20)
1.1-2.0	14(1)	1
2.1-3.0	12(1)	3
3.1-4.0	4(2)	–
4.1-5.0	4	1
5.1-6.0	5(3)	1
6.1-7.0	5	–
7.1-8.0	3	–
8.1-9.0	4	2
9.1-10.0	2	2
10.1-20	12(2)	1
21-30	5(1)	–
31-40	1	–
41-50	2(1)	–
51-60	1	–
61-70	2	–
71-80	1	–
81-90	2	–
91-100	–	–

Four rare or uncommon plant species were recorded during the field survey:

- *Cyperus platystylis* (Cyperaceae): present in six wetlands over a total area of 0.1 ha; very rare in New South Wales although more common in northern Australia where it occurs on floating organic mats (K. Wilson, Natnl. Herb. N.S.W., pers. comm.); recorded only on mats of the introduced *Salvinia molesta* and *Eichhornia crassipes*;
- *Eleocharis philippinensis* (Cyperaceae): present in one wetland; third and southernmost record for the State;
- *Maundia triglochinoides* (Juncaginaceae): present in 30 wetlands and over a total area of 12.1 ha; known range only between Wyong and the Brisbane area (Aston, 1973; Sainty and Jacobs, 1981); considered rare on the New South Wales central coast by Beadle *et al.* (1982); generally rarely collected and of uncertain status (S. Jacobs, Natnl. Herb. N.S.W., pers. comm.);
- *Potamogeton javanicus* (Potamogetonaceae): present in one wetland; only known from the central and north coast regions of the State (Sainty and Jacobs, 1981) and recorded very rarely over this range although it is widespread in northern Australia and overseas (Aston, 1973); given as rare on the central coast by Beadle *et al.*, (1982) and rarely collected from the Sydney region in recent years (R. Coveny, Natnl. Herb. N.S.W., pers. comm.).

The majority of wetlands had dense, broad bands of herbaceous emergents around most of their perimeters (Table 5). The major fringing emergents, by far, were *Persicaria hydropiper* and *Juncus polyanthemus* x *usitatus*. Few wetlands had more than 10% of their margins lined with trees, the result of clearing for grazing. The commonest fringing trees were *Casuarina glauca* and *Melaleuca quinquenervia*.

TABLE 5

Summary of records for condition of marginal vegetation

A Percentage of perimeter with trees			B Percentage of perimeter with emergent vegetation		
Percentage	No. wetlands	% Total no.	Percentage	No. wetlands	% Total no.
91-100	10	2.3	91-100	324	75.0
66-90	12	2.8	66-90	19	4.4
36-65	15	3.5	36-65	32	7.4
11-35	27	6.2	11-35	12	2.8
0-10	368	85.2	0-10	45	10.4
	432	100.0		432	100.0

C. Average density and width of emergent vegetation

Rating	No. wetlands	% Total No.
5 (very dense and wide)	316	73.2
4	26	6.0
3	26	6.0
2	19	4.4
1 (very sparse and narrow)	45	10.4
	432	100.0

About 99% of the wetlands were grazed to some extent by cattle. At least five wetlands had been separated from tidal influence by floodgates or earthen block banks. Drainage had directly affected 220 wetlands (51% of total number) and a wetland area of 12,236 ha (96% of total area). Additional, indirect effects of drainage on other wetlands include separation into undrained sub-basins and could include local lowering of water tables.

The actual hydrological effects of drainage would vary with factors such as the depth of drainage and of water tables and the size of catchments. In general, however, drained wetlands will have reduced storage capacity and will dry more readily compared to undrained ones. It is unlikely that any wetlands on the lower Macleay floodplain have been completely eliminated by drainage, despite Goodrick's (1970) estimates of wetland decline in the region (Table 2). His estimates are based on the elimination of value to waterfowl whereas wetlands were defined in this study by the occurrence of plants adapted to at least seasonal inundation. Many wetlands defined in this way are no longer of value as waterfowl habitat. Some 33% of the wetland area covered by the survey reported here was occupied by two taxa (*Juncus polyanthemus* x *usitatus* and *Persicaria hydropiper*) typical of marginal wetland conditions. Wetland drainage has probably been a major cause of the extensive distribution of these taxa.

Two broad hydrological categories of wetlands were distinguished from the nature of their catchments. The first (Category 1) contains 342 wetlands (79% of total number) with a combined area of nearly 4800 ha (37% of total area) which have catchments extending no higher than the 10 m contour. They are filled only by groundwater and localized runoff from the surrounding alluvial flats and will generally have less stable water levels and will dry more readily than those in Category 2. The second type of wetlands (Category 2), with additional drainages on the bedrock slopes surrounding the floodplain, number 90 (21% of total number) and have an overall area of about 8,000 ha (63% of total area).

Most wetlands in Category 2 have catchments on bedrock smaller than 100 ha but the few large wetlands which make up most of the area of this type are fed by catchments

larger than 1000 ha (Table 6). The catchment sizes for these wetlands are 1100 ha (East Kempsey Swamps, No. 275 in Fig. 1), 1790 ha (Belmore Swamp, No. 350), 5060 ha (Christmas Creek, No. 10) and 13,400 ha (Doughboy Swamp, No. 69). The other very large catchment covers 1880 ha and supplies wetland No. 249 which has an area of only about 1 ha. About 90% of wetlands in Category 2 have catchment area/wetland area ratios of 100 or less (Table 7). About 95% of the area in this type of wetland is fed by catchments that are at most 10 times larger than the individual wetlands. Larger catchments and larger ratios of catchment area/wetland area will generally confer greater permanence on wetlands or on particular parts of large, complex basins. Water levels in these wetlands would generally be more persistent because of the greater effectiveness of any rainfall in refilling the basins and perhaps because of greater base flow from groundwater in large catchments.

TABLE 6

Catchment sizes for wetlands with catchments above the 10 m contour (Category 2)

Catchment size (ha)	No. wetlands	% Total no. Cat. 2	Wetland area (ha)	% Total area Cat. 2
0-10	43	47.8	67.9	0.9
11-100	29	32.2	75.1	0.9
101-1000	13	14.4	503.0	6.3
>1000	5	5.6	7340.8	91.9
	90	100.0	7986.8	100.0

TABLE 7

Ratios of catchment area/wetland area for wetlands with catchments above the 10 m contour (Category 2)

Catchment/ wetland ratio	No. wetlands	% Total no. Cat. 2	Wetland area	% Total area Cat. 2
0-10	54	60.0	7553.8	94.6
11-100	28	31.1	417.7	5.2
101-1000	7	7.8	14.5	0.2
>1000	1	1.1	0.8	–
	90	100.0	7986.8	100.0

Table 8 summarizes the occurrence of seven broad land uses in the catchments of the Macleay floodplain wetlands. Every wetland catchment contains some agricultural use and agriculture is the dominant or sole use in 93% of catchments. Areas of natural vegetation occur in 21% of catchments but occupy the largest parts of only 4% of catchments. None of the wetlands surveyed had completely natural catchments. Forestry, industrial areas, mining (only surface extraction of sand, gravel etc. in the case of the Macleay survey area), urban areas and waste disposal occurred in relatively few catchments and rarely or never occupied the largest proportions.

The tenure of about 98% of the wetlands was solely or dominantly freehold. A small part of the Swan Pool (wetland No. 353) is within Hat Head National Park.

The results reported here are estimates that are strictly valid only for the period of the field survey and for the dates of the aerial photography. The condition of wetlands and their catchments and the tenure of the wetlands will have since changed to some extent with new developments and changes in land use. In particular, short-term dynamics of wetland vegetation will have altered the occurrence of plant species and open water. Further surveys of the wetlands and research on the temporal variability of coastal freshwater wetlands are necessary to quantify and explain such changes.

TABLE 8

Land use occurrence in wetland catchments

Land use	Present (% no. catchments)	Dominant or sole use (% no. catchments)
Agriculture	100.0	93.3
Forestry	1.4	0.9
Industrial area	0.7	–
Mining	2.1	–
Natural vegetation	21.3	4.2
Urban area	5.8	1.6
Waste disposal	1.4	–

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APPENDIX

Occurrence of open water categories and plant taxa (indicates introduced species; + indicates no occurrence greater than 0.1 ha; ns indicates less than 0.1%)*

Taxon/open water category	No. wetlands	% Total no.	Total area (ha) occupied	%Total wetland area
Shallow open water	227	52.5	287.6	2.3
Deep open water	39	9.0	28.4	0.2
Total open water	**232**	**53.7**	**316.0**	**2.5**
HEPATICS				
RICCIACEAE				
Ricciocarpus natans (L.) Corda	1	0.2	+	ns
PTERIDOPHYTES				
AZOLLACEAE				
Azolla filiculoides Lam.	96	22.2	10.8	0.1
A. pinnata R. Br.	72	16.7	12.2	0.1
Total Azollaceae	**160**	**37.0**	**23.0**	**0.2**
BLECHNACEAE				
Blechnum indicum Burm. f.	13	3.0	22	0.2
MARSILEACEAE				
Marsilea hirsuta R. Br.	7	1.6	0.6	ns
M. mutica Mett.	34	7.9	14.7	0.1
Total Marsileaceae	**41**	**9.5**	**15.3**	**0.1**
SALVINIACEAE				
**Salvinia molesta* D. S. Mitchell	14	3.2	32.9	0.3
THELYPTERIDACEAE				
Cyclosorus interruptus (Willd.) H. Ito	1	0.2	+	ns
Total Pteridophytes	**193**	**44.7**	**93.2**	**0.7**
MONOCOTYLEDONS				
ALISMATACEAE				
Alisma plantago-aquatica	10	2.3	0.1	ns
IRIDACEAE				
**Sisyrinchium micranthum*	1	0.2	+	ns
JUNCACEAE				
**Juncus acuminatus*	3	0.7	+	ns
**J. acutus*	1	0.2	+	ns
**J. articulatus*	2	0.5	+	ns
J. bufonius	1	0.2	+	ns
**J. cognatus*	2	0.5	+	ns
J. kraussii	9	2.1	4.1	ns
J. planifolius	2	0.5	+	ns
J. polyanthemus	97	22.5	68.4	0.5
J. polyanthemus x *usitatus*	313	72.5	1117.6	8.8
J. prismatocarpus	36	8.3	1.5	ns
J. usitatus	281	65.0	61.8	0.5
Total Juncaceae	**395**	**91.4**	**1253.4**	**9.8**
JUNCAGINACEAE				
Maundia triglochinoides	30	6.9	12.1	0.1
Triglochin procera	243	56.3	151.2	1.2
T. striata	10	2.3	0.3	ns
Total Juncaginaceae	254	58.8	163.6	1.3
LEMNACEAE				
Lemna minor	31	7.2	0.1	ns
Spirodela oligorrhiza	107	24.8	8.2	0.1
Total Lemnaceae	**110**	**25.5**	**8.3**	**0.1**
PHILYDRACEAE				
Philydrum lanuginosum	31	7.2	6.5	0.1
POACEAE				
**Echinochloa crus-galli*	214	49.5	31.4	0.3
Isachne globosa	4	0.9	+	ns
Leersia hexandra	38	8.8	4.1	ns

COMMELINACEAE				
Commelina cyanea	10	2.3	+	ns
CYPERACEAE				
Baumea articulata	10	2.3	0.5	ns
Bolboschoenus caldwellii	7	1.6	0.8	ns
B. fluviatilis	25	5.8	576.4	4.5
B. medianus	2	0.5	0.7	ns
Carex appressa	175	40.5	293.7	2.3
C. fascicularis	3	0.7	0.5	ns
C. neurochlamys	1	0.2	+	ns
Cladium procerum	1	0.2	+	ns
**Cyperus brevifolius*	53	12.3	4.3	ns
C. difformis	6	1.4	+	ns
**C. eragrostis*	23	5.3	+	ns
C. exaltatus	55	12.7	0.7	ns
C. haspan	5	1.2	+	ns
C. platystylis	6	1.4	0.1	ns
C. polystachyos	38	8.8	2.8	ns
C. sanguinolentus	5	1.2	+	ns
C. trinervis	2	0.5	+	ns
Eleocharis dietrichiana	1	0.2	+	ns
E. equisetina	42	9.7	1844.4	14.5
E. minuta	27	6.3	10	0.1
E. philippinensis	1	0.2	+	ns
E. sphacelata	49	11.3	38.2	0.3
Fimbristylis dichotoma	1	0.2	+	ns
F. velata	1	0.2	+	ns
Isolepis inundata	14	3.2	4	ns
Lepironia articulata	4	0.9	27	0.2
Rhynchospora brownii	1	0.2	+	ns
Schoenoplectus litoralis	8	1.9	0.7	ns
S. mucronatus	10	2.3	+	ns
S. validus	8	1.9	2.2	ns
Total Cyperaceae	**270**	**62.5**	**2807.0**	**22.0**
HYDROCHARITACEAE				
Ottelia ovalifolia	52	12.0	1.4	ns
Panicum obseptum	127	29.4	266.5	2.1
Paspalum distichum	350	81.0	2094.8	16.4
Phragmites australis	11	2.5	1134.6	8.9
**Polypogon monspeliensis*	7	1.6	+	ns
Pseudoraphis paradoxa	2	0.5	25.2	0.2
P. spinescens	5	1.2	20.7	0.2
Sporobolus virginicus	1	0.2	+	ns
Total Poaceae	**393**	**91.0**	**3577.3**	**28.0**
PONTEDERIACEAE				
**Eichhornia crassipes*	71	16.4	94.3	0.7
POTAMOGETONACEAE				
Potamogeton javanicus	1	0.2	+	ns
P. tricarinatus	37	8.6	1.3	ns
Total Potamogetonaceae	**37**	**8.6**	**1.3**	**ns**
SPARGANIACEAE				
Sparganium antipodum	1	0.2	+	ns
TYPHACEAE				
Typha domingensis	1	0.2	+	ns
T. orientalis	18	4.2	17	0.1
Total Typhaceae	**19**	**4.4**	**17**	**0.1**
Total Monocotyledons	**431**	**99.8**	**7930.2**	**62.1**
DICOTYLEDONS				
AMARANTHACEAE				
Alternanthera denticulata	22	5.1	+	ns
APIACEAE				
**Hydrocotyle bonariensis*	22	5.1	5	ns
Lilaeopsis polyantha	2	0.5	+	ns
Total Apiaceae	**24**	**5.6**	**5**	**ns**
ASTERACEAE				
**Aster subulatus*	2	0.5	+	ns
Centipeda minima	7	1.6	2	ns
Cotula coronopifolia	8	1.9	2	ns
C. longipes	3	0.7	0.4	ns
Eclipta prostrata	13	3.0	+	ns

APPENDIX (continued)

Taxon/open water category	No. wetlands	% Total no.	Total area (ha) occupied	% Total wetland area
Enydra fluctuans	4	0.9	+	ns
Pseudognaphalium luteoalbum	1	0.2	+	ns
Total Asteraceae	**29**	**6.7**	**4.4**	**ns**
CALLITRICHACEAE				
**Callitriche stagnalis*	2	0.5	+	ns
CASUARINACEAE				
Casuarina glauca	85	19.7	371.7	2.9
GOODENIACEAE				
Goodenia paniculata	5	1.2	+	ns
HALORAGACEAE				
**Myriophyllum aquaticum*	3	0.7	7.5	0.1
M. latifolium	28	6.5	4	ns
M. sp. (undescribed)	11	2.5	1.2	ns
Total Haloragaceae	**42**	**9.7**	**12.7**	**0.1**
LOBELIACEAE				
Isotoma armstrongii	7	1.6	+	ns
LYTHRACEAE				
Lythrum hyssopifolia	4	0.9	+	ns
MALVACEAE				
Hibiscus diversifolius	1	0.2	+	ns
MENYANTHACEAE				
Nymphoides geminata	2	0.5	+	ns
N. indica	10	2.3	1.2	ns
Total Menyanthaceae	**12**	**2.8**	**1.2**	**ns**
MYRTACEAE				
Callistemon salignus	27	6.3	2.3	ns
Melaleuca linariifolia	20	4.6	5.1	ns
M. quinquenervia	63	14.6	689.9	5.4
M. styphelioides	28	6.5	0.1	ns
Total Myrtaceae	**92**	**21.3**	**697.4**	**5.5**
NYMPHAEACEAE				
**Nymphaea capensis*	25	5.8	8.3	0.1
ONAGRACEAE				
Ludwigia peploides	270	62.5	26.1	0.2
PLANTAGINACEAE				
**Plantago major*	10	2.3	+	ns
POLYGONACEAE				
Persicaria attenuata	1	0.2	+	ns
P. hydropiper	383	88.7	3088	24.2
P. lapathifolia	82	19.0	1.1	ns
P. orientalis	60	13.9	+	ns
P. strigosa FORM 1	21	4.9	2.2	ns
P. strigosa FORM 2	60	13.9	118.2	0.9
P. sp. A	41	9.5	0.5	ns
P. sp. B	60	13.9	59.9	0.5
P. sp. C	1	0.2	+	ns
**Polygonum arenastrum*	4	0.9	+	ns
**Rumex conglomeratus*	99	22.9	0.2	ns
**R. crispus*	16	3.7	+	ns
Total Polygonaceae	**419**	**97.0**	**3270.1**	**25.6**
RANUNCULACEAE				
Ranunculus inundata	162	37.5	31	0.3
R. plebeius	17	3.9	+	ns
Total Ranunculaceae	**168**	**38.9**	**31**	**0.3**
SCROPHULARIACEAE				
Bacopa monnieri	18	4.2	3.9	ns
Total Dicotyledons	**429**	**99.3**	**4431.8**	**34.7**
SURVEY TOTAL			**12771.8**	**100.0**